

Technical Memorandum

TO: Paul Matuska, Manager, Water Accounting & Verification Group, BCOO
FROM: John W. Shields, Agricultural Engineer
SUBJECT: Summary of Method for Calculation of Consumptive Use and Unmeasured Return Flow from the Lower Colorado River Multi-Species Conservation Program (LCR MSCP) Palo Verde Ecological Reserve (PVER) and Computation of 2016 Use and Return Flow
DATE: May 10, 2017

Executive Summary

Reclamation accounts for water use within Palo Verde Irrigation District (PVID) using records of measured diversions, measured return flow and an estimate of ground water return flows. The present methodology estimates unmeasured (ground water) return flows on a district-wide basis using an unmeasured return flow factor of 5.6 percent of the diversion to the District. In light of recently gained understanding of water application practices on PVER, the current method used to compute unmeasured return flow under-estimates the return flow to the River from PVER. This memorandum summarizes the analysis performed to: document the water application, estimated water consumption and return flows back to the Colorado River associated with irrigation of the habitat lands within the LCR MSCP PVER Conservation Area for calendar year 2016, and 2) describe the process to account for the unmeasured return flows associated with irrigation at PVER in the future.

PVER encompasses about 1,350 acres of previously farmed agricultural land located on the floodplain approximately ten miles northeast of Blythe, California. The Trust for Public Lands acquired the Riverview Ranch from the Travis family and subsequently conveyed it to the California Department of Fish and Game (now known as the Department of Fish and Wildlife (DFW)), which identified 1,023 acres of active agricultural lands as suitable for habitat restoration as part of the LCR MSCP. Over 1.8 million riparian trees (cottonwood, willow and/or honey mesquite) and shrubs were planted in an 8-phased program from 2006 through 2013. PVER now provides suitable habitat for terrestrial and bird species, including the endangered southwestern willow flycatcher and the threatened yellow-billed cuckoo.

PVER is managed by the LCR MSCP for habitat mitigation purposes, including maintaining moist soil conditions during the target bird species' breeding and nesting period (spring and summer) for creating suitable microclimate conditions and production of a flying insect food base for those avian species. To date, the water application rate on PVER is much higher than for the PVID croplands. Improving the on-site management of the PVER habitat will result in reduced water application, though it will likely remain higher than for PVID croplands.

The PVER habitat area does not have surface drains or runoff ditches that allow excess irrigation water to be measured as it travels back to the River as return flows; accordingly, the water not consumed returns to the River as groundwater and must be estimated. A separate accounting for the unmeasured return flow from PVER is required as the PVID district-wide unmeasured return flow factor of 0.056, or 5.6 percent, under-estimates the return flow from PVER. This has the effect of attributing a higher annual consumptive use to PVID than is actually occurring.

This analysis has computed the 2016 PVER consumptive use and describes the method Reclamation will use to calculate PVER unmeasured return flows going forward. Reclamation's literature review found that the evapotranspiration (ET) rates for naturally occurring cottonwood/willow habitat varied between 5.1 and 6.3 feet of water per year. As noted above, the consumptive use on PVER includes tree and shrub ET as well as water consumed by evaporation to maintain moist soil conditions during the avian species' spring and summer breeding and nesting season within the cottonwood and willow tree habitat. The only published information found that estimates vegetation consumptive use of water and for maintenance of moist soil conditions was the LCR MSCP's December 2004 *Final Habitat Conservation Plan* (HCP) document. The HCP references a consumptive use rate of 5.93 acre-feet per acre (AF/A) for cottonwood and willow tree habitat which includes a 25 percent increase for moist soil condition maintenance as indicated on page 5-30 of the HCP. Mesquite tree habitat does not include irrigation for maintaining moist soil conditions; therefore only the vegetative portion of the mesquite tree ET, amounting to 4.79 AF/A, (as computed from Table 5-8 of the HCP) is included. Application of these values to the LCR MSCP-managed PVER habitat acreage results in a 2016 consumptive use estimate of 5,918 acre-feet (AF). The amount of water delivered to those lands, as measured by PVID, was 17,304 AF in 2016.

DFW-Managed Habitat: In addition to the land managed by the LCR MSCP, there are two distinct land areas within the PVER managed by DFW. Near the north end of PVER is one area consisting of about 123.6 acres of land that is managed as upland game bird habitat. It is planted into a grain crop that is deficit-irrigated, (i.e., only irrigated once or twice per season), raised to maturity, but not harvested. The grain crop provides food and bird cover. This area is not included in this analysis since agronomic operations, excepting the annual water application amount, are comparable to elsewhere within PVID and will be accounted for in the same manner as agricultural uses within PVID.

The second area of DFW-managed parcels is the "duck pond" area at the south end of PVER, adjacent to the Colorado River and east of Phases 1-3 of the LCR MSCP habitat. Three acres were planted to honey mesquite trees and 63 acres of artificially-constructed pond habitat was planted to Japanese millet in 2016. Japanese millet is well suited for areas with wet conditions. With a tolerance for wet and muddy soil conditions while growing, Japanese millet is able to be flooded while growing as long as its leaves remain above water.

During portions of 2016, the DFW pond area was flooded and standing water was present. Evaporation from the pond area was estimated using average monthly evaporation rates computed from the published 2006 through 2011 Parker, Arizona location values included in the Lower Colorado Region, Bureau of Reclamation's *Estimates of Evapotranspiration and Evaporation Along the Lower Colorado River* reports. The ET rate for the Japanese millet was also computed as the 2006-2011 average of the field grains (field corn, sorghum and milo) values published in the same report. Applicable Food and Agriculture Organization (FAO) publications show the crop coefficients for various types of millet to be the same as for sorghum.

The ET rate table values presented in Reclamation's ET and evaporation reports are based on normal field conditions where irrigation water is being applied for crop production purposes. Within this DFW duck pond habitat, nearly all of the millet was flooded during the August through December period, accordingly, the annual ET rate for the millet was increased by 25 percent (per the LCR MSCP HCP approach for the cottonwood habitat discussed above) to account for the

unique situation of the crop being maintained in a standing water environment, akin to maintaining moist soil unit conditions. Accordingly, the resulting ET for field grains/Japanese millet was estimated to be 36.19 inches (3.02 feet).

In 2016, the total amount of water delivered to the 63 acres of duck pond habitat was 2,324 AF as measured by PVID. The calculated consumptive use of the duck pond habitat area is as follows:

Duck pond evaporation (August through December, inclusive)	114 acre-feet
Mesquite tree evapotranspiration (annual)	14 acre-feet
Japanese millet evapotranspiration (annual)	<u>190 acre-feet</u>
	318 acre-feet

By subtraction, the 2016 return flow attributable to the CA DFW-managed duck pond habitat lands within PVER is $2,324 - 318 = 2,006$ AF.

2016 PVER Habitat Total: The following table shows the water delivered to PVER, the estimated consumptive use and the resulting return flow:

Computation of 2016 Return Flow Amount for the PVER Habitat

PVER Area	Water Delivered (AF)	PVER Consumptive Use (Vegetation & Managed Flooding Requirement) (AF)	Unmeasured Return Flow from PVER Habitat (AF)
All PVER habitat -- exclusive of DFW-managed lands	17,304	5,918	11,387
DFW-managed Duck Pond Area (Parcels 501008 & 501009, totaling 63 acres)	2,324	318	2,006

Pursuant to the Consolidated Decree in *Arizona v. California* (547 U.S. 150, 2006), consumptive use is calculated as total diversions, less measured and unmeasured return flow. Reclamation will calculate the unmeasured return flow for PVID by subtracting the deliveries to the LCR MSCP managed lands within PVER and deliveries to the DFW managed duck ponds, from the total PVID diversion. The standard unmeasured return flow factor will be applied to the resulting diversion amount (i.e., remaining PVID diversion). The calculated unmeasured return from the PVER area (13,393 AF in 2016) will be added to the unmeasured return from the total district at large. In 2016, the total unmeasured return flow from PVID is 55,706 AF.